

# NASA TECH BRIEF

## Lyndon B. Johnson Space Center



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### Lightweight Graphite/Polyimide Panels

Composite construction materials are made from a polymeric resin incorporating fibers of a material such as graphite or boron to improve their strength. By aligning the fibers in the same direction, the materials can be made with strength-to-weight ratios greater than metals. Because of their great strength, these lightweight composites promise to become one of the most important construction materials.

Graphite composite technology has expanded into the area of honeycomb-cored sandwich panels. The panels are constructed of a honeycombed polyimide/graphite core covered with a thin face sheet of the same

material. The fabrication is based on an extension of thin-gage graphite technology and a modification of glass filament polyimide honeycomb techniques.

The honeycomb is prepared from two cross-plyed sheets of prepreg. The prepreps are fabricated by spraying a light film of polyimide resin on a drum. Ribbons of tow-type graphite fiber are then spread to a three-inch (7.6 cm) width and wound onto the drum to produce 7000 filaments per inch (2750/cm). A second light coat of resin is applied, and the prepreg is removed from the drum. After a second prepreg is prepared, the two are crossplyed and pressed together.

TABLE I

HONEYCOMB PANEL STRUCTURAL PERFORMANCE SUMMARY

Design Property	Value	
	25° C PSI	260° C PSI
Facing strength		
Parallel to ribbon	42,000	31,320
Perpendicular to ribbon	>16,750	17,390
Facing modulus (psi x 10 <sup>6</sup> )		
Parallel to ribbon	18 x 10 <sup>6</sup>	17.9 x 10 <sup>6</sup>
Perpendicular to ribbon	5.1 x 10 <sup>6</sup>	5 x 10 <sup>6</sup>
Flatwise sheer strength		
Parallel to ribbon	140	110
Perpendicular to ribbon	80	66
Flatwise compressive strength		
With foam	> 1,000	600
Without foam	194	150
Total panel weight	0.42, lb/ft <sup>2</sup>	

(continued overleaf)

TABLE II

**HONEYCOMB TEST RESULTS**  
**3/8-IN. (0.98 CM) CELL SIZE**

Property	Temperature (° C)	Graphite/Polyimide	Aluminum	Glass/Polyimide
"L" Shear Modulus (psi)	25	32,400	27,000	14,000
	232	27,830	17,010	11,500
"W" Shear Modulus (psi)	25	12,500	13,000	6,000
	232	13,470	8,190	4,900
Compression Modulus (psi)	25	19,600	45,000	20,000
	232	19,650	28,350	16,400
Density (lb/ft <sup>3</sup> )		1.9	2.0	2.5

This two-ply sheet is then dried, corrugated, and cured. The honeycomb is constructed with simultaneous curing of the node bonds and cell webs, an improvement over past techniques that results in a reduced core weight.

The face sheets are made from nine plies of a prepreg fabricated on a drum in the same manner as the honeycomb prepreps. They are pressed together, but this time without the cross-plying.

Finally, the honeycomb and the face sheets are bonded to each other to form the sandwich panel. A polyimide foam is used for edge closure. Bonding by dipping the core into a film of high-temperature adhesive further reduces the panel weight in comparison to fabrication by more usual techniques.

These panels are lightweight, stiff, and are relatively unaffected by temperatures up to 260° C, as shown by the list of properties in Table I. The panels have many properties superior to those of fiberglass or other polymer structures, and at higher temperatures, are better than aluminum, as shown in Table II.

**Note:**

- The following documentation may be obtained from:  
National Technical Information Service  
Springfield, Virginia 22151

**Development of Lightweight Graphite/Polyimide Honeycomb**

**Phase I — Materials Selection**

Reference: NASA CR-115637 (N72-24533)

Single document price \$4.75

(or microfiche \$0.95)

**Development of Lightweight Graphite/Polyimide Sandwich Panels**

**Phase II — Thin Gage Material Manufacture**

Reference: NASA CR-115421 (N72-18577)

Single document price \$4.75

(or microfiche \$0.95)

**Development of Lightweight Graphite/Polyimide Sandwich Panels**

**Phases III, IV, and V**

Reference: NASA CR-12810 (N73-10503)

Single document price \$7.75

(or microfiche \$0.95)

**Patent status:**

NASA has decided not to apply for a patent.

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